Memorandum

DONOHUE

Date: March 3, 2016

DRAFT

To: David Casper, Commissioner
Bruce Siebers, Commissioner
Kevin Coffey, Commissioner
Patrick Hennessey, Commissioner
John Sundelius, Commissioner
Glen Geurts, District Manager
John Johnson, Regulatory Compliance Manager

Copy: Dawn Bartel, HOVMSD
Ed Nevers, Donohue & Associates

From: Tammy Kuehlmann, Donohue & Associates

Re: 2015 Annual Flow Summary
Heart of the Valley Metropolitan Sewerage District

The following memorandum documents the analysis and observations of the 2015 clear water (inflow and infiltration) flow component of the overall HOVMSD wastewater flow.

HOVMSD SUSTAINABILTY PROGRAM

HOVMSD has implemented a self-regulated sustainability program to maintain, monitor, and regulate flow to the WWTP. The goal of the sustainability program is to maintain or extend the longevity of the WWTP and interceptor capacity by not increasing the existing level of clear water in the system and decreasing the clear water entering the system where possible.

Performance indicators provide a degree of insight to relative volume of clear water that is entering the system from the HOVMSD member communities and the impacts of the clear water on the system. For the 2015 yearly evaluation, Donohue reviewed performance indicators from the following sources:

1. Observations at the HOVMSD wastewater treatment plant,
2. Analysis of the clear water components of flow through the Antecedent Moisture Model (AMM),
3. Analysis of the clear water components of flow identified in the Compliance Maintenance Annual Reports (CMAR) for each member community.

The following sections of the memorandum document the observations and analysis of the performance indicators listed above.

OBSERVATIONS AT HOVMSD WASTEWATER TREATMENT PLANT

The performance of the HOVMSD plant is ultimately the issue of greatest concern for the Wisconsin Department of Natural Resources (WDNR). If there are permit violations or steadily increasing secondary treatment diversion events and volumes, the WDNR may increase their oversight or impose flow reduction mandates.

PLANT PERFORMANCE

YEAR	PLANT FLOW (million gallons)	ANNUAL REPORTED PRECIPITATION (inches)	NUMBER OF SECONDARY TREATMENT DIVERSIONS	VOLUME OF DIVERTED FLOW (million gallons/year)
2010	2,390,000	32.25	3	14.258
2011	2,359,297	30.08	1	3.998
2012	1,844,606	17.89	0	0
2013	2,014,113	27.14	1	0.562
2014	2,079,438	29.34	2	3.549
2015	1,887,988	29.93	3	2.185

PLANT SECONDARY TREATMENT DIVERSION DETAILS

DATE	PLANT FLOW (million gallons)	FOX ENERGY PUMPING (million gallons)	VOLUME OF DIVERTED FLOW (million gallons/event)
July 14, 2010	30.824	2.240	12.304
July 15, 2010	21.535	2.045	1.954
August 11, 2010	19.408	0.832	2.360
April 26, 2011	27.177	0.763	3.998
April 10, 2013	22.526	2.221	0.562
April 14, 2014	21.435	0.050	1.718
May 28, 2014	21.958	1.505	1.831
June 15, 2015	15.934	3.277	0.800
September 8, 2015	15.346	2.453	0.027
December 14, 2015	30.390	1.877	1.358

In 2015, HOVMSD was able to provide primary treatment for the total influent volume during every rainfall event. The number of diversions is elevated but the volume of diverted flow is less in 2015 compared to previous years with similar total annual precipitation.

Annual precipitation in 2015 and 2014 was very similar, however, the total plant flow in 2015 was nearly 10% lower than in 2014. While the number of secondary treatment diversions was higher in 2015 compared to 2014, the actual volume of diverted flow was approximately two-thirds of that in 2014. The number and volume of the diversions are is greatly dependent on the frequency and intensity of rainfall events.

Plant flows for the December 13/14, 2015 rainfall event were similar to the peaks flow on July 14/15, 2010. The intensity of the event in July 2010 was greater but the magnitude of the two day rainfall events and the total plant flow were similar and therefore worthy of comparison. The rainfall's impact on the plant diversion in December 2015 was 1/10 that of the July 2010 event.

STORM EVENT COMPARISON: JULY 2010 AND DECEMBER 2015						
LOCATION	JULY 14, 2010	JULY 15, 2010	JULY 2010 EVENT TOTAL	DECEMBER 13, 2015	DECEMBER 14, 2015	DECEMBER 2015 EVENT TOTAL
Plant Rainfall	2.39 in	0.66 in	3.05 in	1.41 in	1.31 in	2.72 in
Kimberly Rainfall	2.92 in	0.35 in	3.27 in	1.25 in	1.50 in	2.75 in
Kaukauna Rainfall	2.76 in	0.45 in	3.21 in	0.95 in	1.33 in	2.18 in
Little Chute Rainfall	3.28 in	0.34 in	3.62 in	1.00 in	1.68 in	2.68 in
Darboy Rainfall	2.63 in	0.43 in	3.06 in	1.09 in	1.58 in	2.67 in
Total Plant Flow	30.824 mgd	21.535 mgd	52.359 mgd	15.603 mgd	30.390 mgd	45.993 mgd
Secondary Treatment Diversion	12.304 mgd	1.954 mgd	14.258 mgd	0 mgd	1.358 mgd	1.358 mgd

Overall, years 2014 and 2015 can be compared to 2010 and 2011. The 2014/15 shows significant flow reductions to the plant and total volume of diverted flow.

ANTECEDENT MOISTURE MODELING

The Donohue used the antecedent moisture model with flow data from 2006-2008 and 50 years of rainfall and temperature data to:

- Calibrate the collection system performance,
- Predict the future plant flows and interceptor performance assuming there were no changes within the system to reduce clear water flow, and
- Extrapolate future plant flows and interceptor performance given completed efforts to reduce the clear water (inflow and infiltration) within the system.

The same model is now used an annual basis to evaluate the yearly, incremental change to the overall system performance.

The member community scatter plots included at the end of the memorandum depict the AMM modeling results.

1. The results are presented as a comparison of the modeled flow versus the measured flow for given rainfall events.
2. The modeled flow is the flow that is predicted for a rainfall event based on the calibrated model.
3. The measured flow is the actual flow measured by a member community meter station or the combined measured flow for a community with multiple meter stations.
4. The diagonal, heavy dashed line represents the point at which the measured flow matches the modeled flow. This is the baseline (2006-2008 reference line) at the beginning of the program and the line to compare progress.
5. For points above the baseline, the modeled flow over-predicts the measured flow. Therefore, the sanitary sewer system is producing less flow than the model would have predicted for the given storm event. It is assumed that this represents clear water reduction progress.
6. For points below the baseline, an individual storm event produced a greater amount of flow than predicted. It is assumed that this represents more clear water in the system than at the point of original calibration.
7. A trend line is given for each year to summarize the analyzed storm events in that given year.
8. Trend line above the dashed, baseline represents clear water reduction progress compared to baseline year.
9. Tread lines below the dashed, baseline represent an increase in clear water in the sanitary sewer system compared to the baseline.
10. In an ideal, closed system where continual clear water reduction occurs, the annual tread lines would be increasing over the dashed baseline.
11. The heavy black, diagonal line is a combined result of all trend lines. A heavy line above the dashed line shows progress. A heavy line below the dashed line shows regression.
12. The goal of the sustainability plan is that the heavy line (a summary of the progress made since 2010) is at or above the dashed line.

The December 2015 rainfall and flow event was not modeled. The model is not calibrated for the conditions surrounding an early winter event. In addition, the flow meters for Combined Locks and Darboy stopped recording data from November 29, 2015 to December 13, 2015 and December 17, 2015 to December 31, 2015.

Observations:

- Kimberly's annual peak shows substantial improvement over all recent years. The three year rolling average is showing continued improvement. This is expected given the peak inflows from the Kimberly Mill have been removed from their system.
- Darboy's peak flows are similar to last year can close to the 2006 reference. The three-year rolling average shows substantial improvement over the previous 3-year averages.
- Little Chute's peak flows are nearly identical to last year and only slighting behind the 2006 reference. Their 3-year average peak flow dropped slightly from last year.
- Combined Locks annual peak flow and 3-year rolling average are continuing to drop.
- Kaukauna's annual peak flow continued to drop in the last three years. The 3-year rolling average dropped slightly but is very consistent with previous years.

The modeled flows represent the impact of peak flows. Communities continue to reduce the base flow component of their total flow by implementing projects such as repairs or replacement of cracked or damaged pipes, manholes, and connections in the sanitary sewer system. These sources of flow are true I/I sources but have a constant flow of water so that they appear to be part of the 'base' flow for the community. Donohue is continuing to try and quantify the impact of such project on the annual peaks.

Member community modeling results showing the *Annual Peak Flows* and *Three Year Rolling Averages of Peak Flows* are included at the end of this memorandum.

MEMBER COMMUNITY CMAR DATA

WDNR requires that member communities and the district prepare annual CMARs and submit them to the WDNR by October of each year. The CMAR has sanitary sewer condition performance indicators that include:

- lift station failures
- sewer pipe failures
- sanitary sewer overflows
- basement backups
- number of complaints
- peaking factor ratio (peak monthly to annual daily average)
- peaking factor ratio (peak hourly to annual daily average)

Annual reported precipitation is provided by HOVMSD based on one regional recording station. Individual community rainfall gages are not used for the annual total precipitation values as they are not in service during frost/freezing susceptible times (late fall to early spring). A summary of the previous performance indicators are summarized in the following tables. A detailed list of CMAR flow data/peaking factor ratios follow.

CMARs from the communities were reviewed to determine the trend in the performance indicators. CMAR summaries are given on the following pages. Observations of note:

- For all communities, the peak hourly event occurred in December. The second and third highest events were on June 15 and September 8 (the ranking depending on the community; Little Chute and Darboy had the September event ranked second, Kaukauna, Kimberly, and Combined Locks had the June event ranked second).
- The December event occurred during a heavy period of rain from December 13-16. The June peak occurred during a heavy period of rain from June 12 and 15-17. The September event occurred during heavy rains on September 8 and 9.
- According to HOVMSD staff, the December event created the highest ever peak flow event for HOVMSD.
- For Kaukauna, and Darboy, the December event was the highest peak hourly flow in the recent 6 years. For all communities, 2015 did not have the highest average top ten peak hourly flows (In 2015, Kaukauna had the second highest top 10 peak hourly flow average, Darboy and Combined Locks was the third highest, Little Chute and Kimberly had the fourth highest).
- In all cases except Little Chute, the December event produced the highest peak hour to daily average ratio in the recent 6 year comparison.
- In every case, the average daily flow was lower in 2015 which has the effect of increasing the peak ratios (monthly and hourly).
- For Darboy, Kimberly, and Kaukauna, the average daily flow was the lowest of the 6 years analyzed. For Little Chute and Combined Locks, 2015 was the second lowest; the lowest being in 2012 when the annual rainfall was substantially less.
- Average daily flows can be lower in part because of long, dry periods and in part because of reductions in the base inflow and infiltration flow (assuming industrial and residential flow remains generally the same).

Kaukauna

KAUKAUNA CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES[1]	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	0	1	0	27
2011	0	1	2	26
2012	0	0	3	32
2013	0	0	2	30
2014	0	0	0	27
2015	0	0	0	17

[1]Kaukauna has five major (traditional) and two minor lift stations. One of the minor lift stations is a semi-public station at the softball fields/1000 Islands Park. The second minor lift station is manually operated to pump leachate from an old landfill. HOV is notified each time the landfill lift station is operated.

KAUKAUNA CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	3.27	1.50	6.17	4.19
2011	30.08	3.42	1.61	4.16	3.25
2012	17.89	2.48	1.37	6.47	3.51
2013	27.14	2.40	1.73	5.38	3.70
2014	29.34	2.64	1.55	6.88	4.13
2015	29.93	2.08	1.73	9.67	5.35

Little Chute

LITTLE CHUTE CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	NA	0	2	2
2011	NA	0	0	0
2012	NA	0	2	2
2013	NA	0	0	0
2014	NA	0	0	0
2015	NA	0	0	0

LITTLE CHUTE CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	1.46	1.66	9.49	5.31
2011	30.08	1.49	2.05	5.65	3.94
2012	17.89	1.16	1.50	5.20	3.71
2013	27.14	1.39	1.75	4.80	3.44
2014	29.34	1.45	1.67	6.01	4.00
2015	29.93	1.25	1.54	9.33	4.27

Kimberly

KIMBERLY CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES[1]	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	1	1

[1]Kimberly has three lift stations. In 2013, one of the lift stations that serviced part of Kimberly mill was taken out of commission. In 2014, one lift station was eliminated. In 2015, one lift station was eliminated. The mill lift station that was previously decommissioned was eliminated. Kimberly has one remaining lift station.

KIMBERLY CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	0.98	1.71	11.07	7.45
2011	30.08	0.84	2.39	8.36	5.19
2012	17.89	0.68	1.53	7.56	5.14
2013	27.14	0.68	2.00	6.62	4.69
2014	29.34	0.75	1.76	9.32	6.32
2015	29.93	0.65	1.46	14.25	5.96

Combined Locks

COMBINED LOCKS CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	NA	0	2	2
2011	NA	0	0	1
2012	NA	0	0	0
2013	NA	0	0	1
2014	NA	0	0	0
2015	NA	0	0	0

COMBINED LOCKS CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	0.38	1.78	10.77	6.55
2011	30.08	0.38	2.13	6.65	4.24
2012	17.89	0.30	1.56	7.74	4.65
2013	27.14	0.34	1.83	6.26	4.03
2014	29.34	0.36	1.75	7.64	5.34
2015	29.93	0.31	1.79	12.04	5.72

Darboy

DARBOY CMAR PERFORMANCE INDICATOR SUMMARY				
YEAR	NUMBER OF LIFT STATION FAILURES	NUMBER OF SEWER PIPE FAILURES	NUMBER OF BASEMENT BACKUP OCCURRENCES	NUMBER OF COMPLAINTS
2010	NA	0	0	0
2011	NA	0	0	0
2012	NA	4	0	4
2013	NA	0	0	0
2014	NA	0	0	0
2015	NA	0	0	0

DARBOY CMAR PEAKING FACTOR RATIOS					
YEAR	ANNUAL REPORTED PRECIPITATION (inches)	ANNUAL AVERAGE DAILY FLOW (MGD)	PEAKING FACTOR RATIO (MONTHLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO (PEAK HOURLY: ANNUAL DAILY AVERAGE)	PEAKING FACTOR RATIO – TOP 10 AVERAGE (PEAK HOURLY: ANNUAL DAILY AVERAGE)
2010	32.25	0.95	1.19	3.60	2.93
2011	30.08	0.96	1.31	2.71	2.36
2012	17.89	0.94	1.11	3.29	2.45
2013	27.14	1.02	1.25	2.76	2.35
2014	29.34	1.06	1.27	2.99	2.29
2015	29.93	0.92	1.14	4.27	2.62

Heart of the Valley Metropolitan Sewerage District

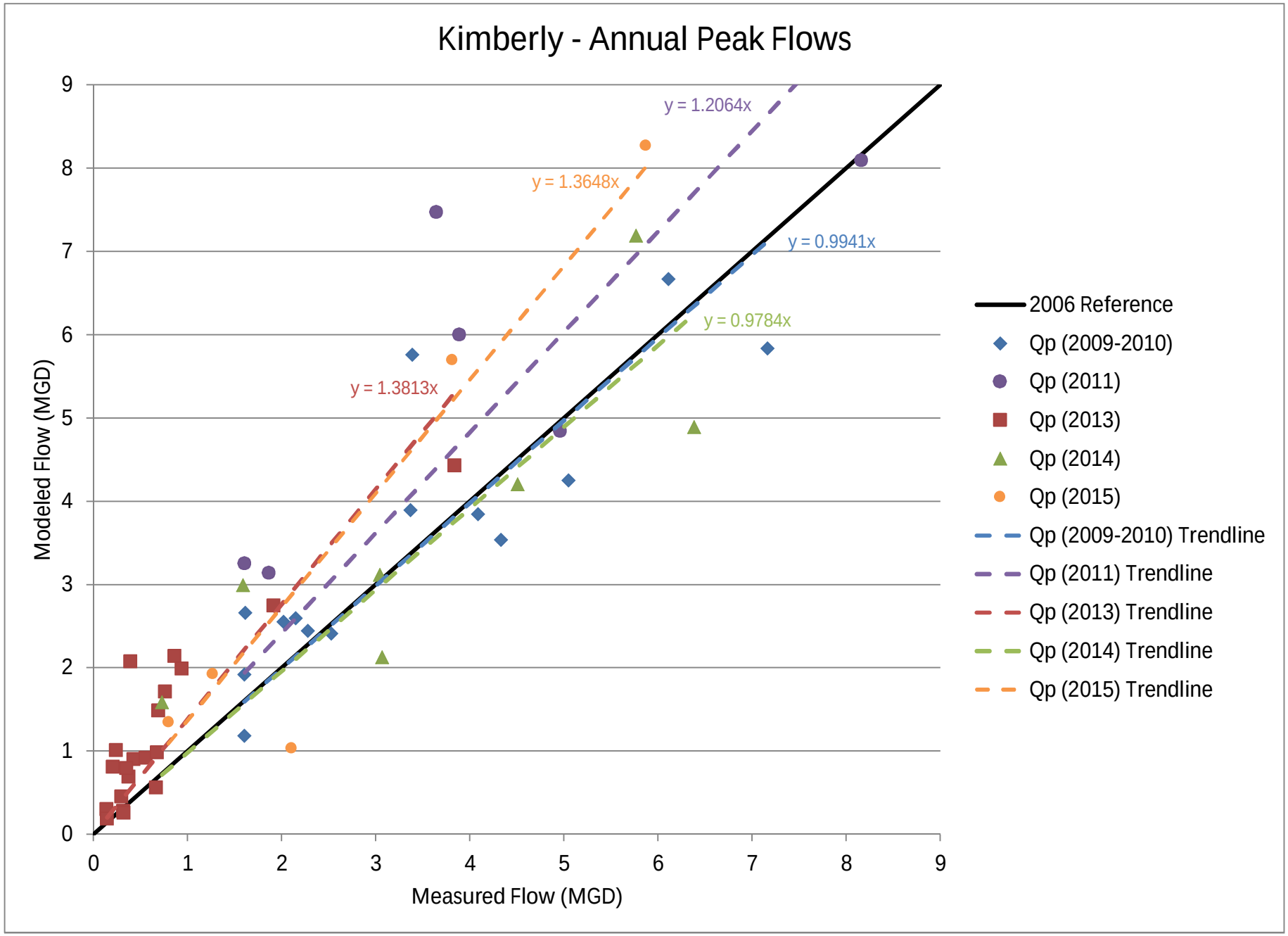
Member Community Compliance Maintenace Annual Report: Peaking Factor Ratios

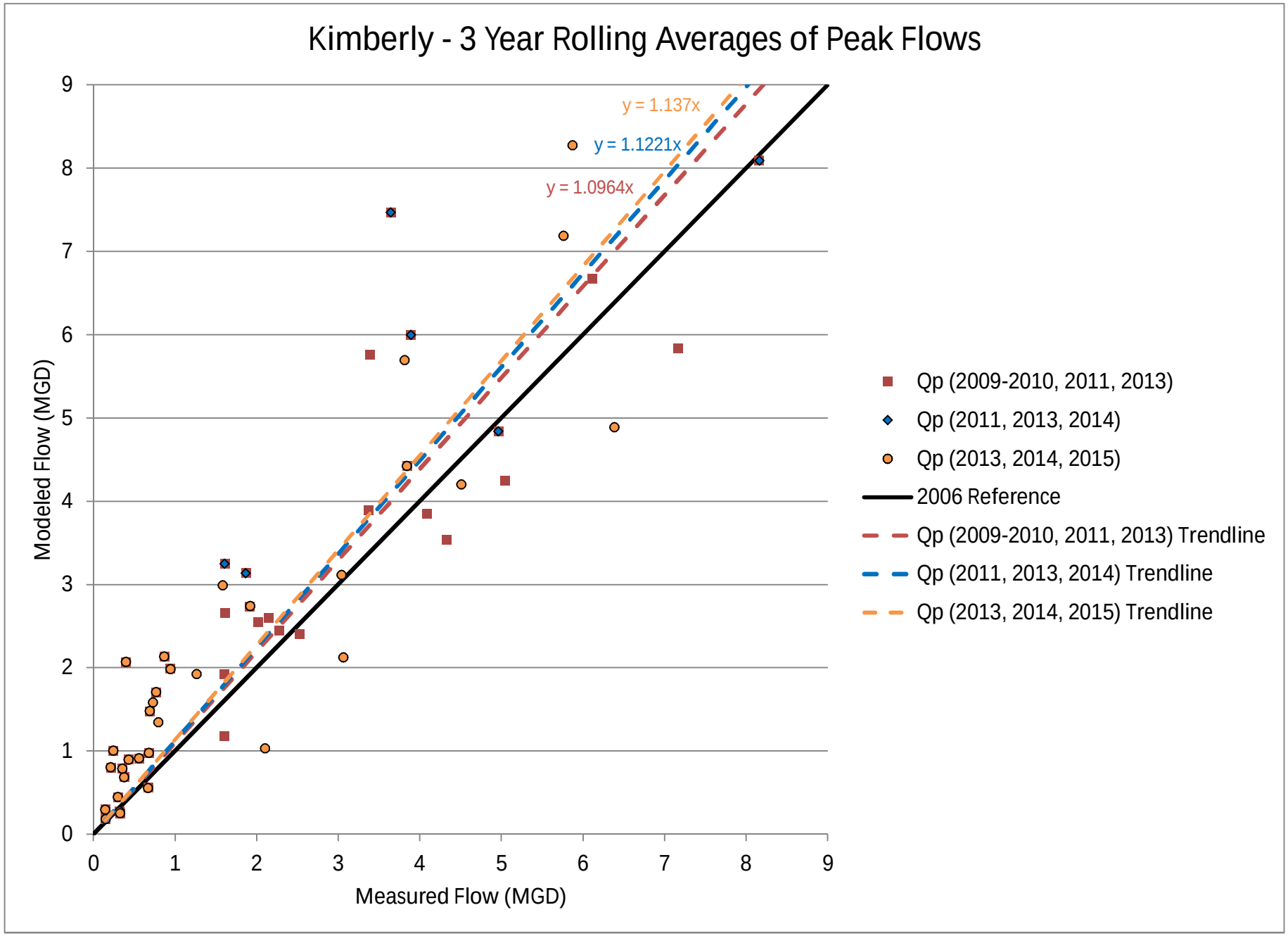
January 2010- December 2015

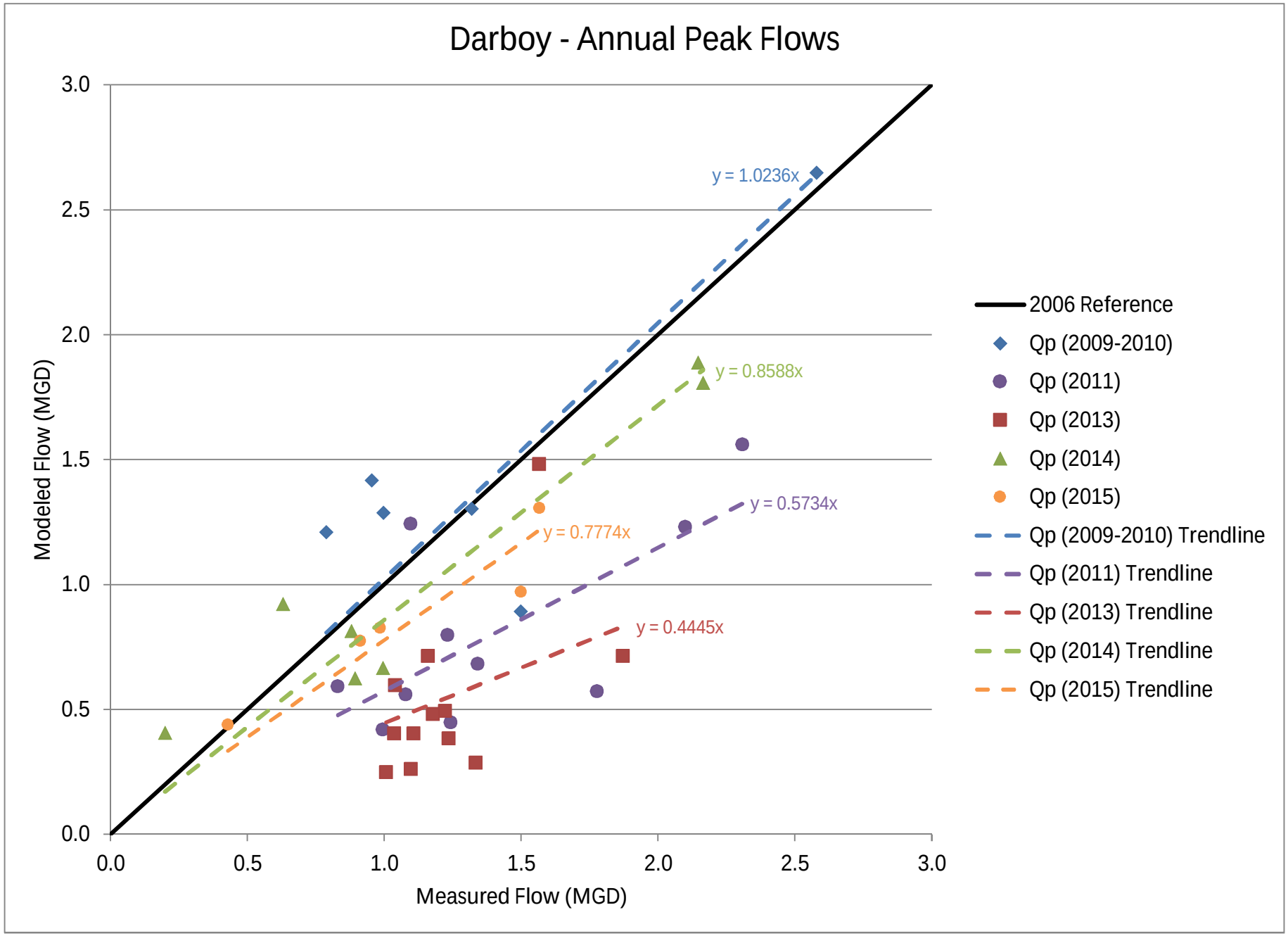
Metric	Kaukauna						Kimberly						Little Chute						Combined Locks						Darboy					
	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015**	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014*	2015	2010	2011	2012	2013	2014*	2015
Average daily flow in MGD	3.27	3.42	2.48	2.40	2.64	2.08	0.98	0.84	0.68	0.68	0.75	0.65	1.46	1.49	1.16	1.39	1.45	1.25	0.38	0.38	0.30	0.34	0.36	0.31	0.95	0.96	0.94	1.02	1.06	0.92
Peak monthly flow in MGD	4.92	5.50	3.39	4.16	4.08	3.59	1.68	2.01	1.04	1.37	1.32	0.95	2.42	3.05	1.73	2.43	2.42	1.93	0.68	0.80	0.47	0.63	0.63	0.56	1.13	1.26	1.04	1.27	1.35	1.05
Month of peak monthly flow in MGD	July	April	March	April	April	December	July	April	March	April	April	December	July	April	March	April	April	December	July	April	March	April	April	December	July	April	March	April	April	December
Peak hourly flow in MGD	20.20	14.22	16.03	12.94	18.16	20.12	10.90	7.05	5.11	4.52	6.99	9.32	13.86	8.42	6.02	6.66	8.73	11.66	4.13	2.51	2.33	2.15	2.73	3.75	3.43	2.61	3.10	2.82	3.18	3.93
Peaking factor ratio Peak Monthly:Annual Daily Avg	1.50	1.61	1.37	1.73	1.55	1.73	1.71	2.39	1.53	2.00	1.76	1.46	1.66	2.05	1.50	1.75	1.67	1.54	1.78	2.13	1.56	1.83	1.75	1.79	1.19	1.31	1.11	1.25	1.27	1.14
Peaking factor ratio Peak Hourly:Annual Daily Avg	6.17	4.16	6.47	5.38	6.88	9.67	11.07	8.36	7.56	6.62	9.32	14.25	9.49	5.65	5.20	4.80	6.01	9.33	10.77	6.65	7.74	6.26	7.64	12.04	3.60	2.71	3.29	2.76	2.99	4.27
Top 10 peak hourly flow in MGD: 1	20.20	14.22	16.03	12.94	18.16	20.22	10.90	7.05	5.11	4.52	6.99	9.32	13.86	8.42	6.02	6.66	8.73	11.66	4.13	2.51	2.33	2.15	2.73	3.75	3.43	2.61	3.10	2.82	3.18	3.93
2	18.90	12.50	10.74	12.93	15.95	20.12	10.02	4.62	4.83	4.07	6.77	6.55	12.20	6.42	5.91	5.62	8.13	6.63	3.19	1.77	2.01	1.92	2.58	2.90	3.34	2.58	2.78	2.67	2.80	2.76
3	18.04	12.30	9.66	9.98	14.62	17.42	9.71	4.47	4.46	3.91	6.22	4.47	11.10	6.07	5.44	5.49	7.12	6.19	3.18	1.59	1.64	1.51	2.44	2.58	3.24	2.52	2.72	2.51	2.75	2.45
4	17.76	11.40	8.67	9.40	10.70	8.31	8.04	4.32	4.07	3.78	5.18	2.97	8.66	6.01	4.45	5.44	6.25	5.61	3.17	1.58	1.37	1.37	2.44	1.36	2.82	2.26	2.38	2.45	2.41	2.28
5	10.78	10.19	7.38	8.45	10.66	8.28	7.66	4.14	3.17	3.15	4.93	2.86	7.39	5.61	3.92	4.98	5.34	4.49	2.79	1.54	1.17	1.24	1.78	1.32	2.82	2.18	2.10	2.44	2.37	2.22
6	10.64	10.19	7.26	7.33	7.99	8.01	6.06	4.10	2.81	2.75	3.89	2.68	5.25	5.51	3.63	4.27	5.11	4.07	1.96	1.53	1.16	1.22	1.77	1.28	2.76	2.16	2.06	2.33	2.27	2.18
7	10.58	10.18	7.02	7.22	7.92	7.71	5.33	4.05	2.77	2.64	3.84	2.62	5.01	5.49	3.43	4.00	4.96	4.04	1.85	1.49	1.14	1.21	1.54	1.26	2.70	2.14	2.03	2.26	2.18	2.15
8	10.43	10.04	6.76	7.01	7.67	7.64	5.27	3.98	2.66	2.58	3.70	2.55	4.75	5.10	3.41	3.83	4.59	3.61	1.65	1.41	1.11	1.14	1.32	1.14	2.37	2.12	1.98	2.21	2.17	2.14
9	10.01	9.98	6.76	6.90	7.67	6.76	5.22	3.63	2.44	2.35	2.95	2.51	4.67	5.04	3.34	3.77	3.99	3.53	1.61	1.30	1.08	1.04	1.29	1.11	2.35	2.08	1.96	2.17	2.15	2.01
10	9.77	9.95	6.75	6.87	7.57	6.68	5.07	3.37	2.44	2.26	2.93	2.49	4.67	5.00	3.32	3.69	3.87	3.47	1.59	1.27	0.99	1.00	1.24	1.10	2.09	2.05	1.96	2.15	2.09	1.99
Peaking factor ratio Ave Top 10 Peak Hourly: Annual Daily Avg	4.19	3.25	3.51	3.70	4.13	5.35	7.45	5.19	5.14	4.69	6.32	5.96	5.31	3.94	3.71	3.44	4.00	4.27	6.55	4.24	4.65	4.03	5.34	5.72	2.93	2.36	2.45	2.35	2.29	2.62
Ave Top 10 peak hourly flow in MGD	13.71	11.10	8.70	8.90	10.89	11.12	7.33	4.37	3.48	3.20	4.74	3.90	7.76	5.87	4.29	4.77	5.81	5.33	2.51	1.60	1.40	1.38	1.91	1.78	2.79	2.27	2.31	2.40	2.44	2.41

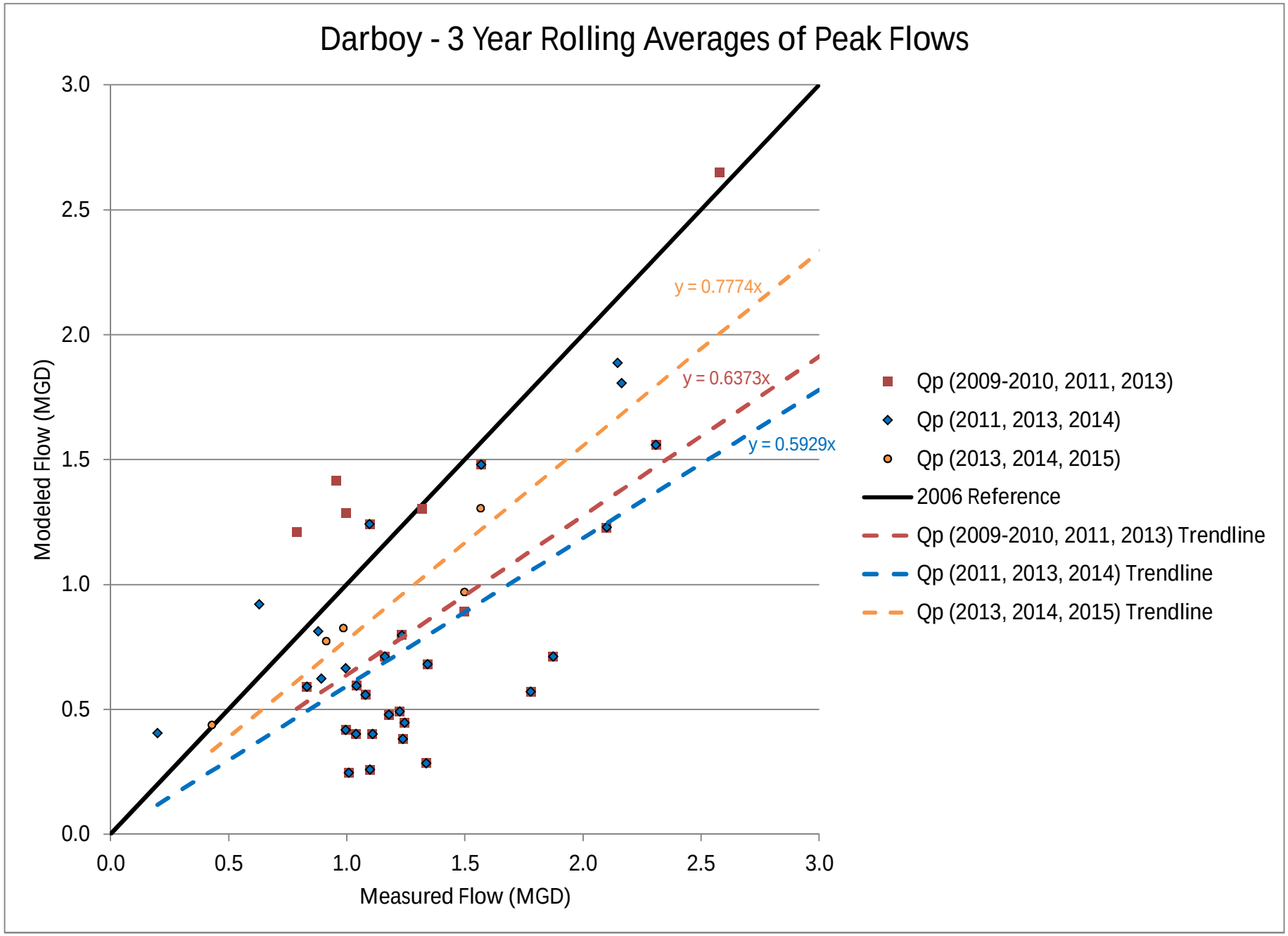
Peak monthly flow is the highest average rate for any given calendar month
Peak hourly flow is the highest average rate for any four consecutive 15-minute reporting intervals

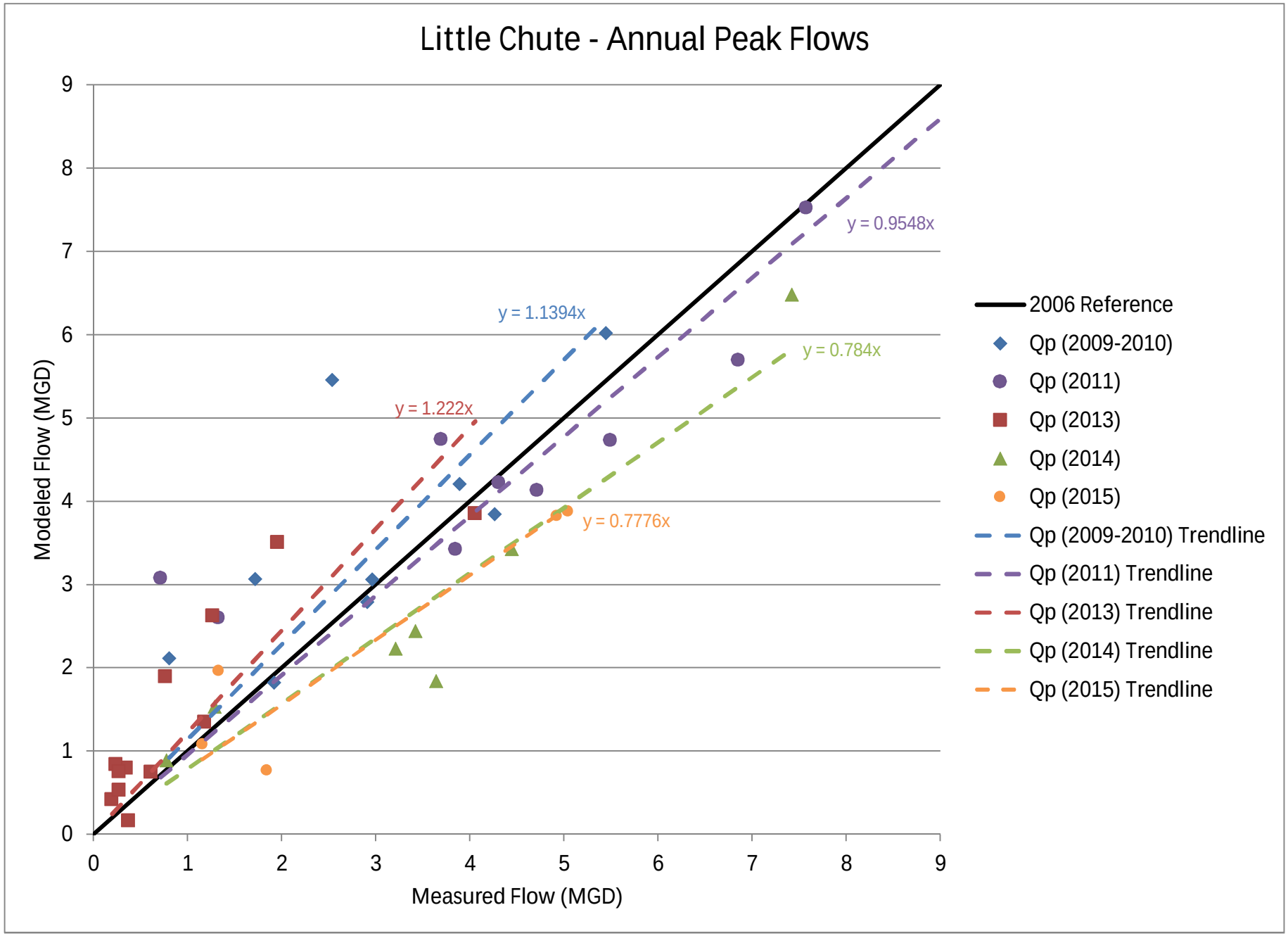
*Note: Data from 7/9/14 9:00 to 7/15/14 16:45 at Combined Locks and Darboy meter stations was omitted from analysis. Interceptor maintenance caused surcharging at meter station.
**Note: Data from 6/9/15 17:30 to 6/11/15 14:00 at the Kimberly meter station was omitted from analysis.
Data on the table represents the highest monthly and peak hourly flows rates outside of the maintenance time period.

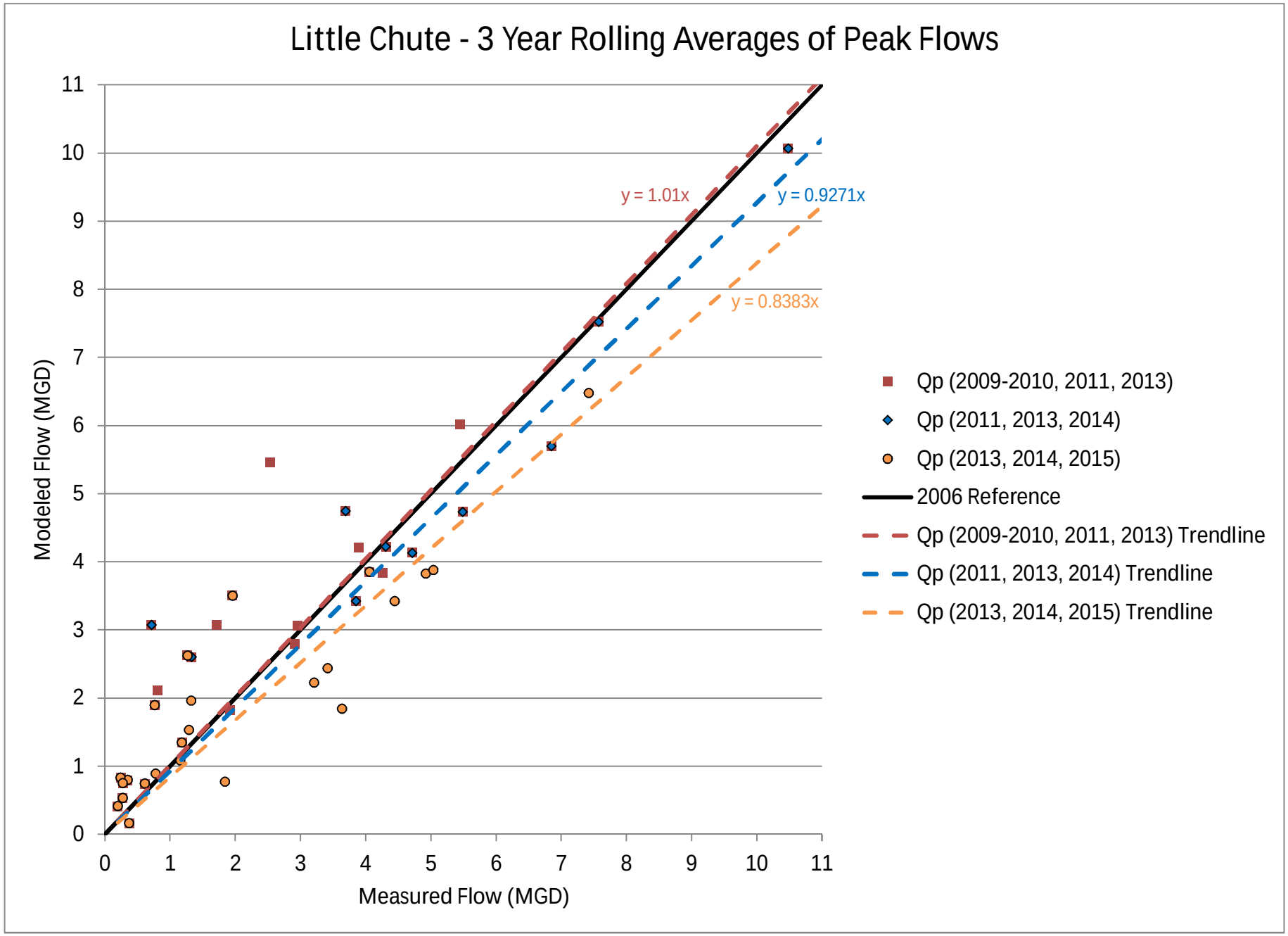

Kimberly - Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
y = 1.2064x
y = 1.3648x
y = 0.9941x
y = 0.9784x
y = 1.3813x
2006 Reference
Qp (2009-2010)
Qp (2011)
Qp (2013)
Qp (2014)
Qp (2015)
Qp (2009-2010) Trendline
Qp (2011) Trendline
Qp (2013) Trendline
Qp (2014) Trendline
Qp (2015) Trendline

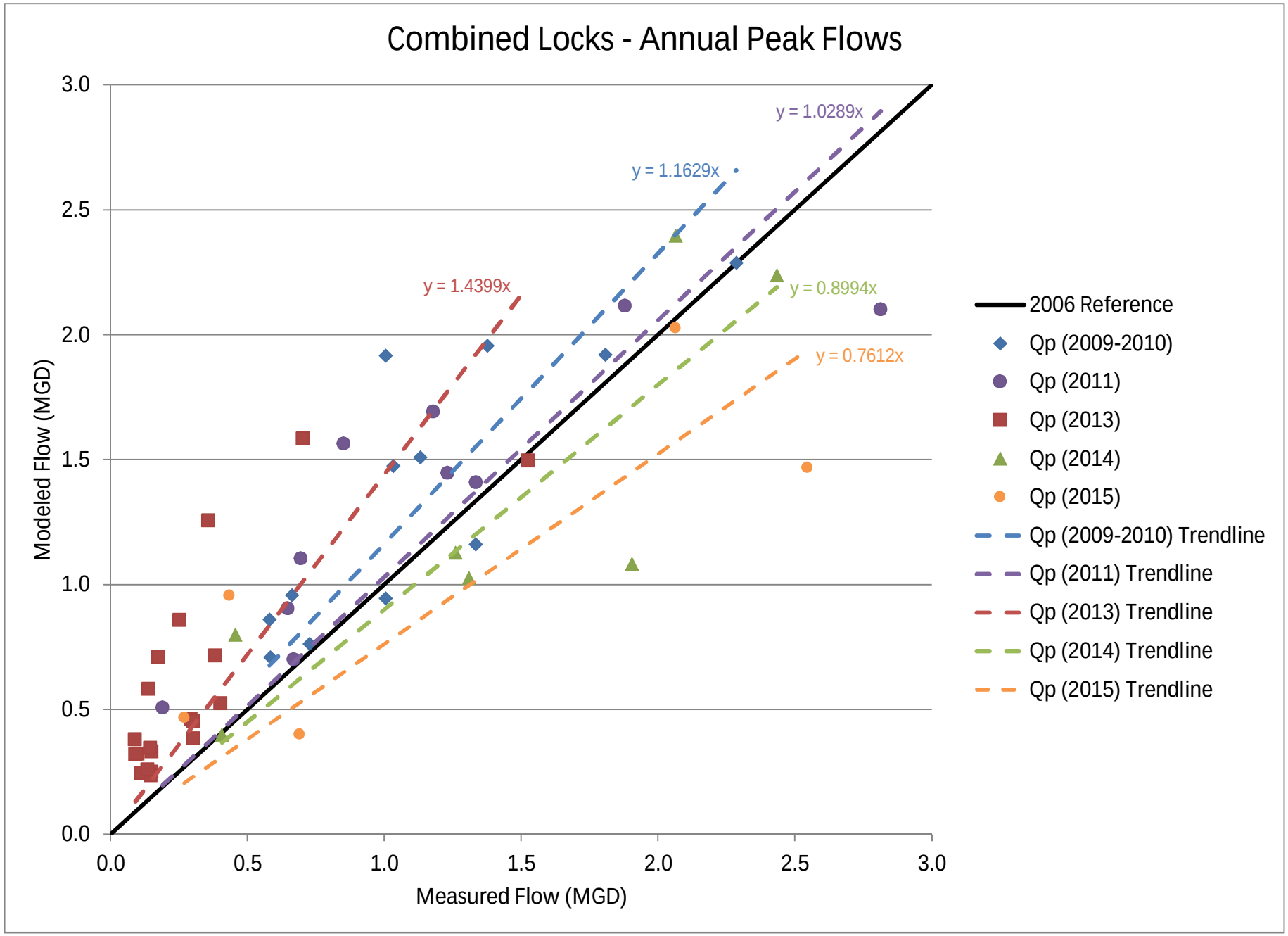

Kimberly - 3 Year Rolling Averages of Peak Flows
y = 1.137x
y = 1.1221x
y = 1.0964x
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Qp (2013, 2014, 2015)
2006 Reference
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline
Qp (2013, 2014, 2015) Trendline

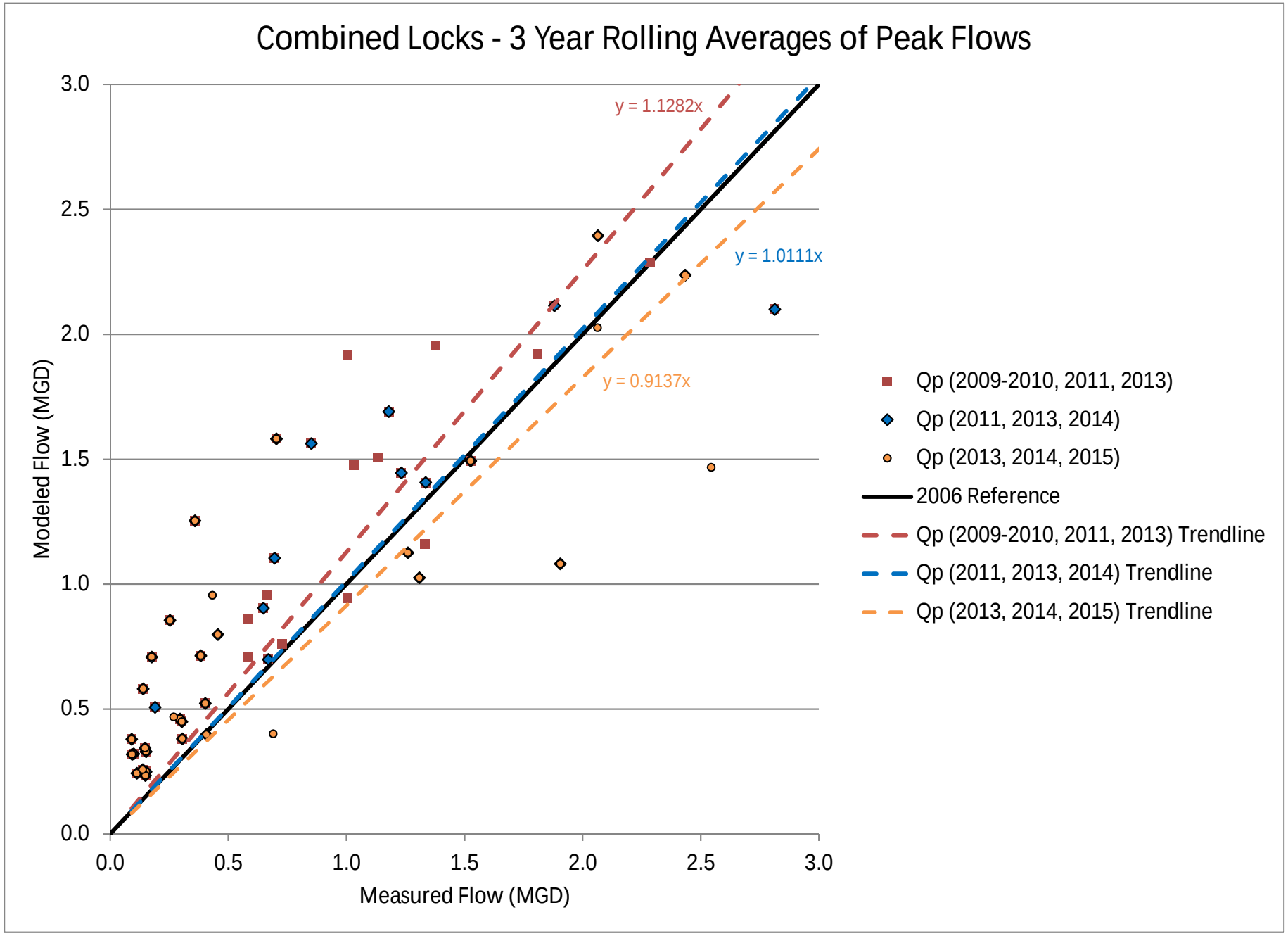

Darboy - Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
y = 1.0236x
y = 0.8588x
y = 0.5734x
y = 0.7774x
y = 0.4445x
2006 Reference
Qp (2009-2010)
Qp (2011)
Qp (2013)
Qp (2014)
Qp (2015)
Qp (2009-2010) Trendline
Qp (2011) Trendline
Qp (2013) Trendline
Qp (2014) Trendline
Qp (2015) Trendline

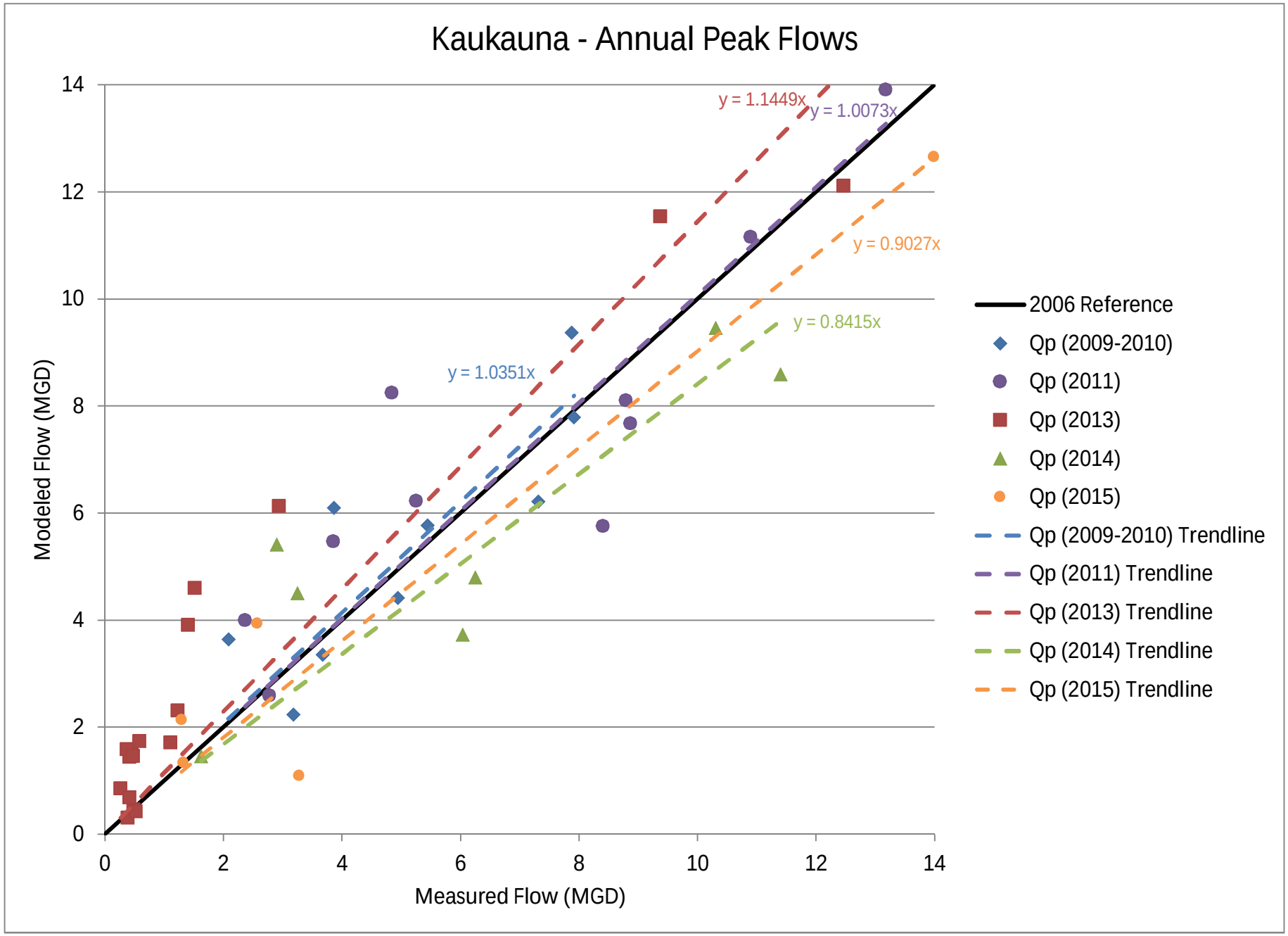

Darboy - 3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
y = 0.7774x
y = 0.6373x
y = 0.5929x
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Qp (2013, 2014, 2015)
2006 Reference
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline
Qp (2013, 2014, 2015) Trendline

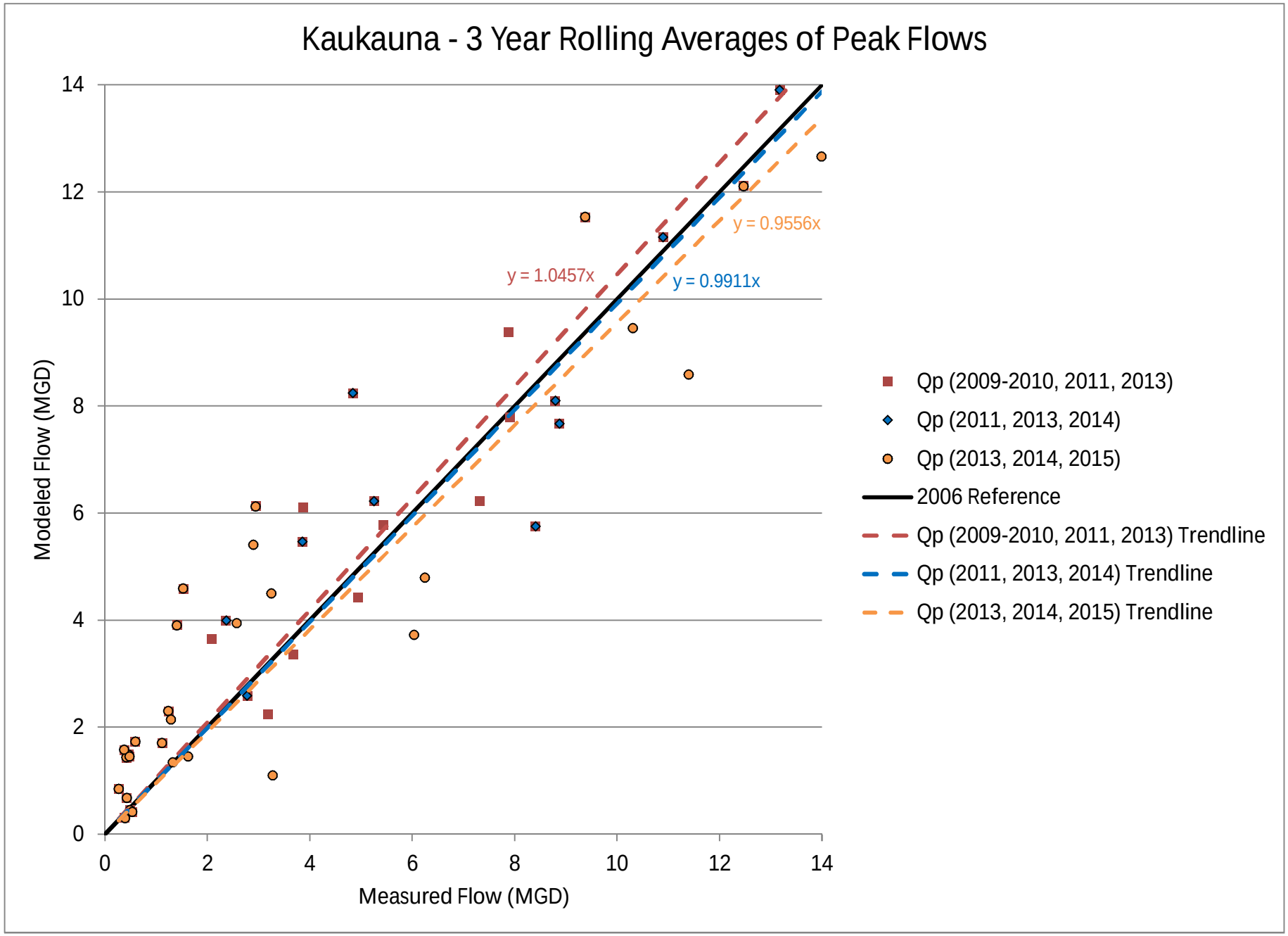

Little Chute - Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
y = 1.1394x
y = 0.9548x
y = 1.222x
y = 0.784x
y = 0.7776x
2006 Reference
Qp (2009-2010)
Qp (2011)
Qp (2013)
Qp (2014)
Qp (2015)
Qp (2009-2010) Trendline
Qp (2011) Trendline
Qp (2013) Trendline
Qp (2014) Trendline
Qp (2015) Trendline


Little Chute - 3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
1
2
3
4
5
6
7
8
9
10
11
y = 1.01x
y = 0.9271x
y = 0.8383x
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Qp (2013, 2014, 2015)
2006 Reference
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline
Qp (2013, 2014, 2015) Trendline


Combined Locks - Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
y = 1.0289x
y = 1.1629x
y = 1.4399x
y = 0.8994x
y = 0.7612x
2006 Reference
Qp (2009-2010)
Qp (2011)
Qp (2013)
Qp (2014)
Qp (2015)
Qp (2009-2010) Trendline
Qp (2011) Trendline
Qp (2013) Trendline
Qp (2014) Trendline
Qp (2015) Trendline


Combined Locks - 3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
y = 1.1282x
y = 1.0111x
y = 0.9137x
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Qp (2013, 2014, 2015)
2006 Reference
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline
Qp (2013, 2014, 2015) Trendline


Kaukauna - Annual Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
2
4
6
8
10
12
14
y = 1.1449x
y = 1.0073x
y = 0.9027x
y = 0.8415x
y = 1.0351x
2006 Reference
Qp (2009-2010)
Qp (2011)
Qp (2013)
Qp (2014)
Qp (2015)
Qp (2009-2010) Trendline
Qp (2011) Trendline
Qp (2013) Trendline
Qp (2014) Trendline
Qp (2015) Trendline


Kaukauna - 3 Year Rolling Averages of Peak Flows
Modeled Flow (MGD)
Measured Flow (MGD)
0
2
4
6
8
10
12
14
y = 1.0457x
y = 0.9911x
y = 0.9556x
Qp (2009-2010, 2011, 2013)
Qp (2011, 2013, 2014)
Qp (2013, 2014, 2015)
2006 Reference
Qp (2009-2010, 2011, 2013) Trendline
Qp (2011, 2013, 2014) Trendline
Qp (2013, 2014, 2015) Trendline